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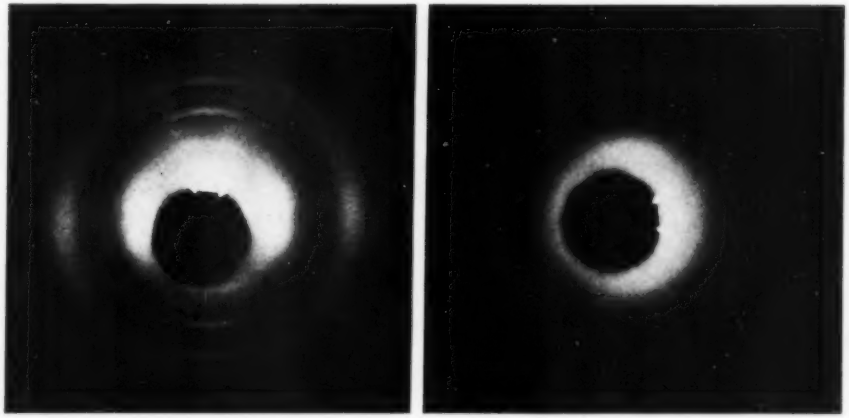

X-RAY STRUCTURE-PHOTOS OF NORMAL AND "FLIGHTLESS" FEATHERS

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Cancer in Jews and Gentiles

The German Sterilization Law

Tetraploid Tomatoes from a Triploid

Twisted Wheat and Twisted Trees

Physics and Chemistry of Life

Interaction of Heredity and Environment

Complementary Lethal Genes

The Wheat Breeder's "Cake"

VOLUME 25 JULY, 1934 NUMBER 7

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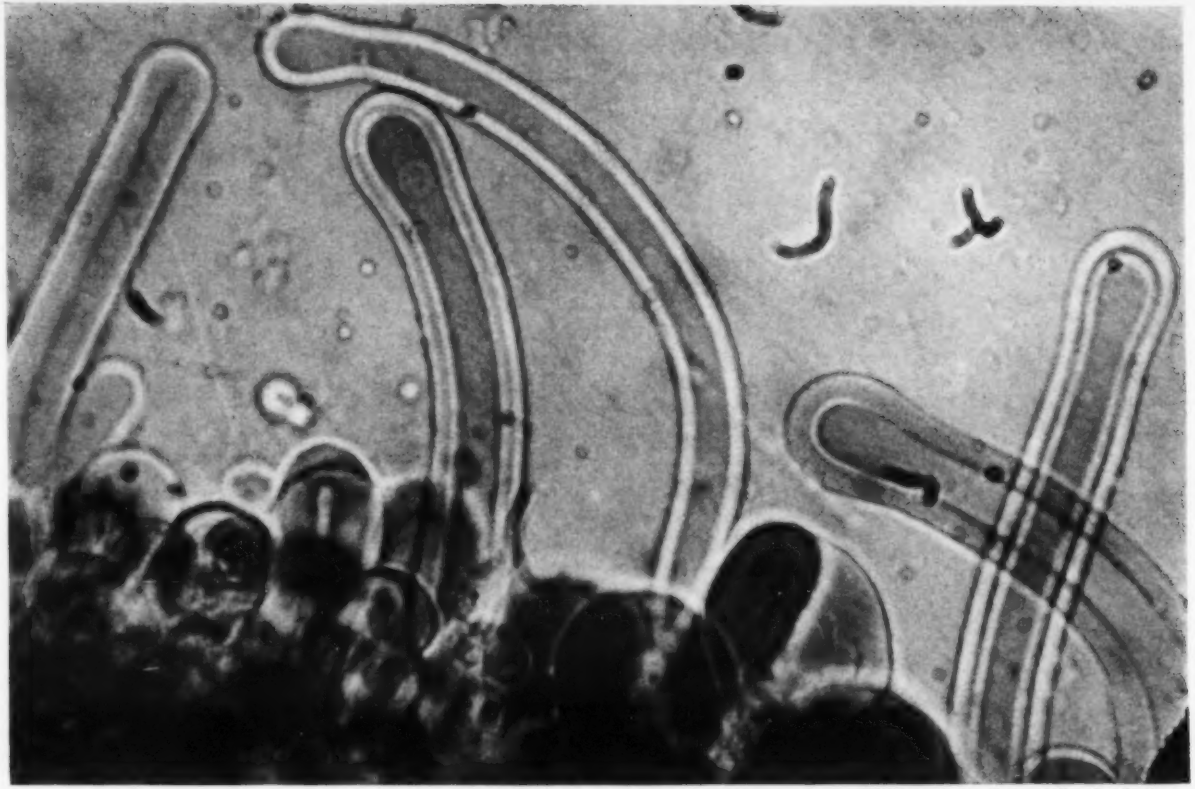

A MODEL OF A LIFE PROCESS *Photograph courtesy of Dr. R. Beutner*

Frontispiece

Life processes can be studied by constructing physio-chemical models that reproduce various vital functions, and by studying how these functions are produced. The above photograph shows such a non-living model of growth processes,—fibers "growing" from a lipoid into the surrounding watery medium. While such fibers have an astonishing resemblance to some living organisms, they exhibit only a few of the properties of protoplasm. They may be taken to show, however, that the explanation of the phenomena of growth does not necessitate the evocation of any mysterious "vital forces" different from the forces studied by physicists and chemists. It has been said that life in all its complexity is "only one of the innumerable properties of the compounds of carbon," though laboratory proof of this is still far from complete. (See "The Physics and Chemistry of Life," page 269.)

THE GERMAN STERILIZATION LAW

PAUL POPENOE
Human Betterment Foundation, Pasadena

GERMANY'S eugenic sterilization law, which went into effect on January 1, 1934, is no hasty improvisation of the Nazi regime. It has been taking shape gradually during many years, in the discussions of eugenists. From one point of view, it is merely an accident that it happened to be the Hitler administration which was ready to put into effect the recommendations of specialists.

But Hitler himself—though a bachelor—has long been a convinced advocate of race betterment through eugenic measures. Probably his earlier thinking was colored by Nietzsche, but he studied the subject more thoroughly during his years in prison, following the abortive revolutionary movement of 1923. Here, it is said, he came into possession of the two-volume text on heredity and eugenics, by E. Baur, E. Fischer, and F. Lenz, which is the best-known statement of eugenics in the German language, and evidently studied it to good purpose. In his book, *Mein Kampf*, most of which was written during these prison years, and which outlines most of the policies since adopted by the Nazis as a political party, he bases his hopes of national regeneration solidly on the application of biological principles to human society.

"He who is not sound and worthy in body and mind, should not perpetuate his handicaps in the bodies of his children," Hitler declares in this book.

"The state must take care that only he who is sound shall be a parent.

"To prevent defective persons from producing equally defective offspring, is an act dictated by the clearest light of reason. Its carrying out is the most human act of mankind. It would prevent the unmerited suffering of millions of persons, and above all would, in the end, result in a steady increase in human welfare."

That he has no illusions about producing immediate and miraculous results, but is taking the long time view, is evidenced by his remark that, "If for only 600 years the reproduction of the physically defective and mentally diseased were prevented, not only would mankind be freed from an unmeasurable misery, but it would reach a vigor which today is hardly dreamed of.

"In an age when races are poisoning themselves," he concludes, "any state which devotes itself to the care of its best racial elements must some day dominate the earth."

He recognizes, however, that negative measures are not enough to safeguard the racial values of a people. There must be an encouragement of sound parenthood, and he declares that "the fertility of sound women must not be limited by the disgusting materialism which transforms the blessing of children into a curse for their parents." While he points clearly to the need for financial reforms, such as the family wage, he seems to lay the greatest stress on educational changes and reforms in public opinion, that will promote earlier marriage and larger families among the fit.

Since the Nazis came into full power, changes have been so frequent that it has been difficult to keep track of them. The sterilization law was one of the first eugenic measures to be adopted. Its text, in full, is as follows:

SECTION 1

(1) Anyone with hereditary disease may be rendered sterile by surgical means, when, according to medical experience, it is highly probable that the offspring of such person will suffer from severe inherited mental or bodily disorders.

(2) The law applies to all who suffer

from any of the following diseases:

1. Congenital feeble-mindedness.
2. Schizophrenia (dementia præcox).
3. Manic-depressive insanity.
4. Inherited epilepsy.
5. Huntington's chorea.
6. Hereditary blindness.
7. Hereditary deafness.
8. Severe hereditary malformation.

(3) Also, anyone with severe alcoholism may be sterilized.

SECTION 2

(1) Anyone in need of sterilization may voluntarily ask for such operation. If the subject is incompetent or mentally weak, or if he has not yet completed the 18th year, his legal representative must intervene and obtain the approbation of the Court of Wards (Vormundschaftsgericht, minor's court). In other cases of limited competence the assent of the legal representative is necessary. In the case of an adult for whom a guardian has been appointed, the consent of the latter must be obtained.

(2) To the application, the certificate of a physician licensed to practice in Germany is to be appended, stating that the person to be sterilized has had the purpose and consequences of sterilization explained to him.

(3) The application can be withdrawn.

SECTION 3

Sterilization can also be proposed by:

1. The official physician.
2. For inmates of a hospital, sanatorium, or nursing home or a prison, the director.

SECTION 4

The proposal is to be presented to the office of the Eugenics Court (Erbgesundheitsgericht) in writing, or dictated to its clerk. The facts on which the proposal is based are to be certified by a medical report, or verified in some other manner. The Clerk of the Court has to notify the official physician of the proposal.

SECTION 5

The Eugenics Court of the district in which the person to be sterilized has his legal residence, will have jurisdiction in the case.

SECTION 6

(1) The Eugenics Court is to be attached to a Magistrate's Court. It shall consist of a Magistrate as chairman, an official physician, and another physician licensed to practice in Germany, who is especially conversant with the principles of eugenics. Every member must have an alternate.

(2) As chairman, no one can officiate who has approved a proposal according to Section 2, No. 1. If an official physician has made the proposal he can not take part in the decision.

SECTION 7

(1) The procedure before the Eugenics Court is not public.

(2) The Eugenics Court has to institute the necessary investigation; it can examine witnesses and experts, can order the personal appearance and medical examination of the person to be sterilized, and can have the latter brought in case of unexcused absence. For the examination and administering of oaths to witnesses and experts, and for the exclusion and excusing of the Court personnel, the rules of civil procedure are to be followed. Physicians called as witnesses or experts are obliged to testify without regard to professional secrecy. Officials of the Court and of other departments of the government, and also hospitals, have to give information to the Eugenics Court on request.

SECTION 8

The Court is to make an unbiased decision on the basis of all the facts and testimony. The decision is to be formulated after oral discussion, and by a majority vote. It is to be in writing, and signed by those members of the Court who approved it. It must give the reasons for which sterilization is ordered or denied. The decision shall be communicated to the proposer, to the official physician, and to the person to be sterilized, or in case the latter is not legally competent, to his legal representative.

SECTION 9

Within one month after the judgment, any of the persons indicated in the foregoing section can appeal in writing, or dictation at the office of the Eugenics Court. Such appeal effects a postponement. The Eugenics Superior Court decides on the appeal. If no appeal is entered, the case returns to its previous status in accordance with the rules of civil procedure.

SECTION 10

(1) The Eugenics Superior Court is attached to a district Superior Court, the two jurisdictions being co-extensive. It consists of a member of the Superior Court of the district, an official physician, and another physician licensed to practice in Germany and especially familiar with eugenics. Every member is to have an alternate. Section 6, No. 2 applies.

(2) Sections 7 and 8 apply to the procedure of the Eugenics Superior Court.

(3) The decisions of the Eugenics Superior Court are final.

SECTION 11

(1) The surgical operation necessary for sterilization can be performed only in a hospital, by a physician licensed to practice in Germany. The physician can undertake the operation only after the legal

steps have been completed. The administrative officials designate the hospitals and the physicians for the performance of the operation. The operation can not be done by a physician who proposed it, or who took part in the legal procedure.

(2) The operator has to give the official physician a written report on the sterilization, with details of the method followed.

SECTION 12

(1) If the Court has given final decision for sterilization, the operation is to be performed even against the will of the person concerned, unless the latter alone voluntarily made the proposal. The Commission may obtain necessary assistance from the Police Officials. If other measures do not suffice, the use of force is permitted.

(2) If circumstances seem to require a new investigation of the situation, the Eugenics Court shall reopen the procedure, and in the meantime forbid the operation. If a proposal of sterilization has been denied, it can be filed again only if new evidence is submitted.

SECTION 13

(1) The costs of the legal proceedings are borne by the State Treasury. The costs of the surgical operation are borne by the Sickness Insurance Fund in case the person concerned is insured, for other indigent persons by the budget for public charity. In all other cases, the cost up to the minimum of the medical fee list, and the average charge for care in public hospitals, is borne by the State Treasury, any cost above that by the person sterilized.

SECTION 14

A sterilization not performed according to this law, as well as a removal of the reproductive glands, is only permissible when a physician removes the glands according to the rules of medical science to lessen serious danger to the life or health of the person operated upon, and with the permission of the latter.

SECTION 15

(1) All persons taking part in the legal steps or the surgical operation are bound to secrecy.

(2) Anyone who illegally transgresses the obligation of silence, shall be punished by imprisonment up to one year, or a fine. Prosecution can only ensue on a complaint. The complaint may be made by the presiding officer.

SECTION 16

(1) It is the duty of the State Government to enforce the provisions of this law.

(2) The Supreme Authority of the State determines the seat and district of the deciding court in accordance with the provisions of Section 6, No. 1, sentence 1, and Section 10, No. 1, sentence 1. It names the members of the Commission and their alternates.

SECTION 17

The Minister of the Interior, in agreement with the Minister of Justice, issues the necessary regulations and rules of procedure for the administration of this law.

SECTION 18

This law goes into effect January 1, 1934.

The administration of this law is being carried out in the light of the regulations and forms officially prepared, together with full and explicit data to guide the courts in deciding who is to be declared hereditarily handicapped. All this material fills a substantial volume.*

Progress in setting up this machinery has been slow, calling forth a number of complaints and admonitions from the administration; but in this delay is evidence that the government is doing its best to set up the necessary 1,700 tribunals carefully and to avoid serious mistakes. While the German law is well drawn and, in form, may be considered better than the sterilization laws of most American states, the success of any such measure naturally depends on conservative, sympathetic, and intelligent administration. Apparently the Nazis are doing their best to prevent criticism on this score, no doubt with the realization that their actions are regarded with suspicion in many quarters.

Newspaper accounts have generally said that 400,000 people are to be sterilized under this law. The statement appears to be unfounded. What German authorities have said is that about 400,000 people would be examined, to determine whether they should be sterilized. This number of course includes the inmates of all hospitals for the mentally diseased,

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*Gütt, Arthur, Rüdin, Ernst, and Ruttke, Falk. *Gesetz zur Verhütung erbkranken Nachwuchs von 14 Juli, 1933, mit Ausführungsverordnung, Erläuterungen, etc.* Pp. 272. Munich, J. F. Lehmann's Verlag, 1934.

institutions for the mentally deficient, homes and asylums for the blind, deaf, and other defectives, and the inmates of all prisons. Naturally, not all of these will be sterilized, though all will be examined with that in view. The first reports from hospitals for mental diseases indicate that about one-third of the inmates are being certified for sterilization. The regulations governing the administration of the sterilization law provide among other things that no one shall be sterilized who because of age or other reasons is not capable of reproduction, or when such an operation would endanger his life. It is further provided that anyone who is in an institution need not be sterilized so long as he remains there.

This provision is a particular aid to the Roman Catholics, who have been combating the sterilization law. Although Hitler himself is a Roman Catholic, that church, as everyone knows, has been the source of a large part of his opposition, and it has taken a strong stand against sterilization in Germany. In order to avoid difficulties, the government came to a more or less official understanding with the representatives of the Vatican, under which (1) no Roman Catholic judge shall be asked to sit on a sterilization court, (2) no Roman Catholic surgeon shall be asked to perform an operation for eugenic sterilization, and (3) no Roman Catholic, otherwise liable to sterilization, shall be sterilized so long as he remains in an institution, at the expense of his family or at the expense of the church. In pursuance of this policy, the church was invited to establish additional institutions, in which its defective members might be taken care of.

Hitler is surrounded by men who at least sympathize with the eugenics program. The various private associations in the field of eugenic education have been reorganized as governmental agencies. The Minister of the Interior has established a commission of experts on population policy, which is elaborating further measures to be adopted. These will doubtless include far-reaching provision for equalizing the economic burdens of the family. Dr. Gütt, in charge of public health measures in the Reich, is also an ardent eugenist.

Among other changes, Dr. Fritz Lenz of Munich was called to the University of Berlin, where a full professorship of eugenics was established for him. He also took over the direction of the eugenic section of the Kaiser Wilhelm Institute for Anthropology, Human Heredity, and Eugenics, at Berlin. This was originally a private endowment, established largely through the activities of Dr. Hermann Muckermann, the eminent Roman Catholic eugenist. As a former Jesuit, and a devoted adherent of the Roman church, Dr. Muckermann evidently could not work successfully with the Nazi regime.

The policy of the present German government is therefore to gather about it the recognized leaders of the eugenics movement, and to depend largely on their counsel in framing a policy which will direct the destinies of the German people, as Hitler remarks in *Mein Kampf*, "for the next thousand years." Whether this policy will be carried through successfully, of course remains to be seen. At best, mistakes will be inevitable. But the Nazis seem, as this scientific leadership becomes more and more prominent in their councils, to be avoiding the misplaced emphasis of their earlier pronouncements on questions of race, and to be proceeding toward a policy that will accord with the best thought of eugenists in all civilized countries.

In any case, the present German government has given the first example in modern times of an administration based frankly and determinedly on the principles of eugenics. It has thus posed the question in a way that no other people can ignore.

TWISTED WHEAT AND TWISTED TREES

Twisting of the Rachis of Wheat Heads by Short Daily Photoperiods Suggests a New Appoach to Studies of Twisted Trees

H. H. McKinney and W. J. Sando

Division of Cereal Crops and Diseases, U. S. Department of Agriculture

DURING the past four years several observers have published on the twisting of the trunks and branches of trees. These papers have dealt with observations, and in some instances there have been discussions as to the possible cause of twisting. The writers are presenting the results of tests with an abnormal twisting of the rachis which occurs in certain varities of wheat when grown under suitable conditions.

During the spring of 1930 it was found that many plants of Harvest Queen wheat developed very long twisted internodes at the lower portion of the rachis of the heads when the plants received light for eight hours daily. Other tests have shown that this twisting occurs in this variety when the daily photoperiod is twelve and one half hours in length during the autumn. Twisting has occurred in Siberian spring wheat when the summer day was reduced to thirteen hours of light. Examples of twisting are illustrated in Figure 1. Twisting has not occurred when the daily photoperiod was fourteen hours or more in length.

Twisting has been associated with the elongation of the internodes at the base of the rachis. In some instances this elongation is slight, but in others the lowermost internode has measured as much as 6 inches. A few specimens have been observed in which elongated internodes were not twisted. These internodes have been twisted as many as two and one half revolutions. Frequently the entire rachis is twisted, and sometimes the complete stem is twisted, but the latter condition is not frequent.

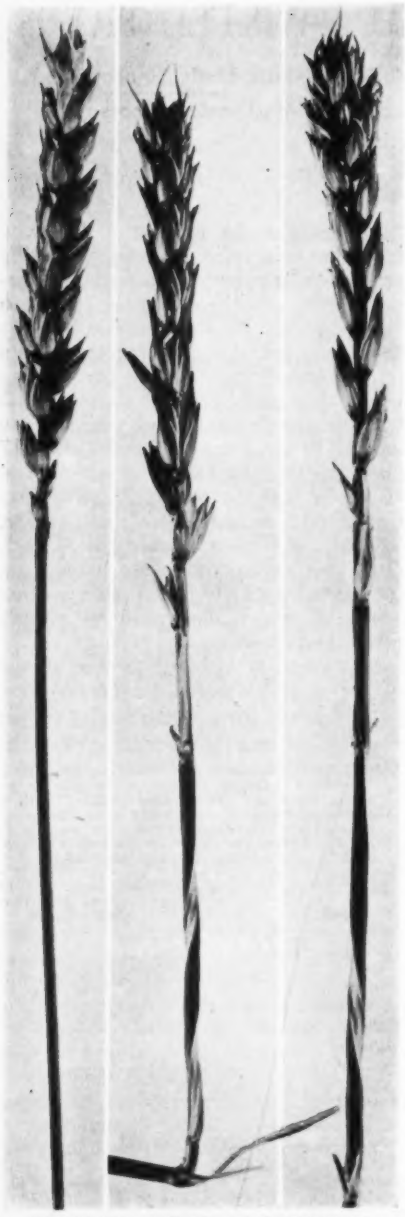
The direction of the twist of the rachis seems to be influenced by some condition arising in the separate stalks as single plants have been found to produce heads with dextrorse (left to right) twists as well as heads with sinistrorse (right to left) twists. Counts on 15 heads from 4 plants of Marquis wheat showed 9 heads with no twists, 3 with dextrorse, and 3 with sinistrorse twists. Counts on 66 heads from 17 plants of Harvest Queen wheat showed 15 heads with no twists, 25 with dextrorse, and 26 with sinistrorse twists. In 7 of the Harvest Queen plants both directions of twisting were present on the same plant, and in 2 of these plants some of the stalks produced heads which had no twists.

In Table I it will be observed that 4 of the varieties tested did not develop twisted heads when grown under condi-

TABLE I. Characteristics of wheat varieties with respect to twisting of the internodes of the rachis when the plants were cultured with a daily photoperiod of eight hours until after heading. Temperatures during the night were 70 to 75° F. During the day they went to 80° F. or slightly above when the sun was bright.

Varieties	Lower internodes of the rachis elongated and twisted*
Spring	
Baart	+
Bunyip	−
Federation	+
Hard Federation	+
Marquis	+
Prelude	−
Quality	−
Reward	+
Sevier	+
Sonora	+
Winter	
Harvest Queen	+
Rising Sun	−
Turkey	+

*Plus signs in the column signify twisting and the minus signs signify no twisting.



TWISTED HEADS OF WHEAT

Figure 1

Twisting of the rachis and clavateness in Harvest Queen wheat (right and center) compared with a normal head showing a considerable portion of the peduncle (left). The normal head has short rachis internodes, but the abnormal heads show elongation and twisting of the lower rachis internodes.

tions favoring twisting in the remaining 9 varieties.

Romanov spring wheat has exhibited pronounced twisting of the rachis when grown near 70 to 75°F. in continuous light (sunlight supplemented with light from a tungsten source) during the winter and spring when the light intensity during the night was reduced to 2 foot-candles and less. When the light intensity at night was increased beyond 2 foot-candles, twisting did not take place. Siberian and Marquis varieties developed no twisting or perceptible elongation in this test. Twisting and elongation of the lower internodes of the rachis has taken place at temperatures ranging from 60 to 90°F.

Usually the spikelets on the nodes of the very long twisted internodes are abortive, and in many instances two leaflike structures developed from the lowermost node of the rachis as shown in the center specimen in Figure 1. This specimen illustrates bending at the base of the twisted rachis, a condition which occurs frequently. Sometimes stem branches develop from the nodes of the rachis in place of the spikelets, and in the case of Marquis such a branch produced several leaves and nodes and a head with abortive flowers.

On the basis of the behavior of the varieties listed in Table I it seems reasonable to assume for wheat, as Knorr[3] does for timber trees, that the twisting described is controlled by heritable factors. However, in the writers' tests twisting was not expressed in varieties possessing the factors except when short days obtain, or when artificial illumination was of very low intensity during winter nights, as cited for Romanov wheat.

In the case of trees it appears to the writers that environmental relation-

ships are still open for rather careful consideration. Granting that the character of twisting is controlled by heritable factors the expression of the character may be due to the environment in which the twisted specimens are growing.

Butler[1] believes that sunlight influences twisting, and he presents the proposition that right-hand twisting prevails in northern latitudes, whereas left-hand twisting prevails in southern latitudes. On this basis twisting should be at the minimum on the equator. As stated above, it appears that the direction of the twist is incidental in wheat.

Tests on the length of the daily light period and on light intensity could be carried out with tree seedlings from seed obtained from twisted and straight-grained trees of the same species. Such tests may be conducted with controlled light conditions at one station, and they may be conducted at various stations along a north and south line in order to determine the influence of climatic differences, especially light conditions, due to differences in latitude. It would be of interest to make a survey from the north and south extremes to the center of the natural habitats of several species to determine if the percentage of twisted individuals is correlated with latitude.

Copisarow[2] infers from the spiral tree forms produced in the Liesegang phenomenon by forced irregular diffusion in a mixed solution of pure sodium carbonate and pure calcium chloride in vitro, that certain salts when present in the soil may cause spiral or twisted trunks in forest trees. While such may be the case, the inference seems to be rather far-fetched when it is considered that no experimental work was carried out with living plants and that the so-called "trees" of the Liesegang phenomenon in reality are only pseudo trees of almost microscopic dimensions.

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Sex Differences in Reaction to Environment

PITFALLS in the study in growth rates in experiments in genetics and in nutrition are suggested by Bird and Gutteridde (*Sci. Agric.* 14: 433-437, April, 1934). In a nutritional experiment carried out on F_1 hybrids of Barred Plymouth Rocks × Single Comb White Leghorns, they show significantly different reactions to the treatment on the part of the two sexes. The females were rendered more variable by one of the diets used, which same diet appeared to have a considerable retarding effect on the growth of the males. Combining the data for the two sexes with a conversion factor (as is sometimes done to increase the experimentalist's sense of statistical security through the use of larger numbers), would have masked these interesting variations. "Hence it is obvious that results obtained on varying stock and under different environmental regimes will vary as any of several factors may favor or hamper one or the other sex as the case may be."

"FLIGHTLESS" FEATHERS

Figure 2

Above is shown a "flightless" rooster, and below "flightless" feathers on the left and normal on the right. "Flightless" is a dominant gene which affects the development of the shaft of the larger feathers causing them to lack the strength of the normal feather so that they break off when any strain is put upon them. X-ray analysis shows that the internal structure of the two types of feathers is entirely different.

A CHEMICAL AND X-RAY STUDY OF "FLIGHTLESS" FEATHERS

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*Kansas State College**

IN a recent article, Warren[5] has called attention to a condition of the feathers of chickens known as flightless. A brief description of the feathers is given here. When the feathers are mature enough to be dry, they become brittle and break, not bend, at a very slight pressure. Only a part of the shaft is left after breaking and it has a characteristic roughened scaly appearance. The feathers break when the bird attempts to fly. (See Figure 2.)

At the time Warren's experiment was being conducted, our attention was called to this flightless condition. A chemical and structural study was made of the defective feathers, and of normal feathers from birds of the same age. The feathers were taken from the wings of the birds, all of which were twelve weeks of age. The quills and about two inches of the shaft, from which the barbs had been removed, were used for the analyses. Total and cystine sulphur, nitrogen, and phosphorus were determined, and an X-ray examination made.

A previous examination of casein and eggs has shown that the total sulphur determined on the dry sample and the sample after hydrolysis were the same within experimental error. As our supply of flightless feathers was limited, it was decided to hydrolyse them and then take aliquot portions for the different determinations. The weighed samples of both defective and normal feathers were placed in long neck Kjeldahl flasks of 500 cc. capacity. Twenty cc. of concentrated HCl were poured over these and allowed to stand overnight. The next morning the feathers were practically dissolved. This solution was then boiled gently, using a reflux condenser, for twenty-four hours. At the end of that time, aliquot parts were taken for the determination of total sulphur by the familiar magnesium nitrate ashing method[1]. Cystine sulphur was determined on the norite-treated hydrolysate according to Sullivan's colorimetric method.[4] Aliquot portions were also taken for nitrogen and phosphorus determinations. The results obtained are given in the Table I.

Although the total nitrogen and the total sulphur were the same in both types of feathers, there seems to be a significant difference in both the cystine sulphur and the phosphorus. The cystine sulphur was 22.7 per cent higher in the normal feathers, and the phosphorus was less than one-half of that in the defective feathers.

Much may be learned concerning strength, toughness and structure of both organic and inorganic materials by recourse to X-ray analysis.[2,3] This method may be used to show the location and alignment of the submicroscopic units or micelles in a material, and thus supply the mechanical or physical reason for the observed characteristics. It was believed that this method of analysis might differentiate between the normal and flightless feathers.

A brief outline of the theory of X-ray analysis will here be given. If a beam of X-rays of wave length λ be directed against some possible crystal plane at an angle θ to it, a beam of diffracted rays will be "reflected" from the plane at the same angle and will

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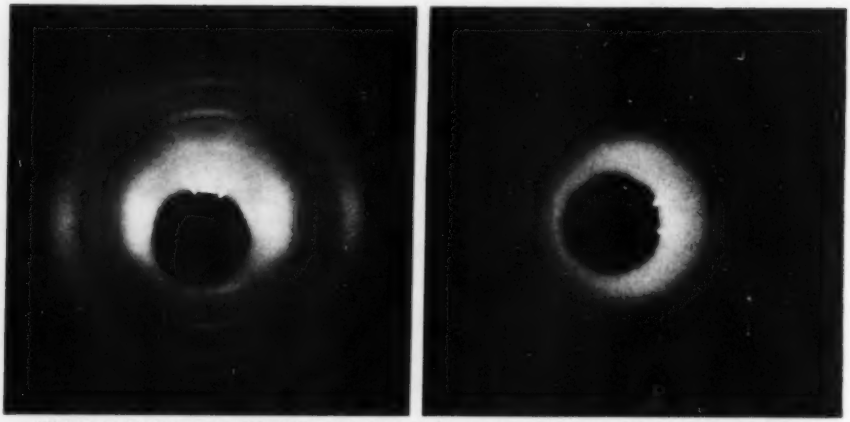

REFRACTION PATTERNS OF NORMAL AND "FLIGHTLESS" FEATHERS
Figure 3

At the left is shown the pattern produced on a photographic plate by X-rays passing through a quill of a normal feather. At the right is the pattern produced by X-rays passing under similar conditions through the quill of a "flightless" feather. The symmetrically spaced lighter areas in the "photograph" of the normal quill show that it has a definite fiberous structure which reflects the X-rays in a regular manner, to produce this pattern on the negative. The lack of such light spots in the "flightless" photograph shows that the feather lacks a definite structure. This is the type of pattern produced by photographing through amorphous or finely divided crystaline substances having no definite pattern. It appears that the "flightless" gene lacks the ability to organize the feather structure in definite fibers as is the case in normal development.

be reinforced by reflections from all parallel planes provided the Bragg equation for X-ray diffraction, $n\lambda = 2d \sin \theta$, is satisfied. In this equation "n" is the order of the diffraction and "d" is the distance between the successive parallel atomic planes. If a narrow beam of the rays is directed through a single crystal, secondary radiation will be emitted from every series of atomic planes for which the Bragg equation is satisfied, and will be recorded on a properly placed photographic film. With a heterogeneous X-radiation this set-up will give the Laue or "spot" pattern. If a purely mono-chromatic ray is used, very few, if any, spots will be produced due to the small likelihood that any particular angle, will exactly satisfy the $n\lambda = 2d \sin \theta$ condition. A different condition prevails if instead of a single crystal, a quantity of finely powdered crystalline material is to be studied. Here, due to the perfectly random orientation of the myriads of small crystals, every possible angle is presented to the beam of X-rays and hence, although λ be single valued, all possible reflections are produced. This gives rise not to individual spots on the film, but to complete rings or circles about the central beam, produced by the overlapping of countless reflections at definite angles to the central beam but extending radially from it.

In the case of fibres, the conditions

TABLE I. Chemical Analysis of Flightless and Normal Feathers

Determination	Flightless—%	Normal—%
Phosphorus	0.184	0.082
Nitrogen	12.4	12.2
Protein (calculated)	77.5	76.25
Total Sulphur	2.59	2.69
Cystine Sulphur	1.89	2.32

are similar, except an orientation of micelles has been accomplished which tends to point the same axis of all the minute crystals in one direction. This "lining-up" of the diffracting particles tends to concentrate the reflected radiation, which in the powder pattern is evenly distributed around the circle, at certain definite maxima. The degree to which this concentration is complete, is a measure of the perfection of the fibering of the material. It is this degree of fibering that distinguishes the normal from the abnormal feathers.

X-ray diffraction patterns were made of the normal and of the flightless feathers using the K α radiation from a copper-target X-ray tube. A pinhole assembly producing a 0.4 mm. beam was employed, the specimen of quill was secured directly over the outer pinhole and 5.0 cm. from the film. A single thickness of the shaft, taken near the base of the feather was used, and this was mounted vertically and normal to the beam. Exposures averaged about fifteen hours at 30 Kilo-volts and 20 milli-amperes.

Decided differences were found to exist between the patterns from the normal and the flightless feathers (Figure 3). The normal feather shows two sets of very distinct maxima at right angles to each other, and a third weaker set at forty-five degrees. The set of maxima parallel to the feather shaft consists of not less than eight pairs of narrow arcs; the set normal to the feather, of two broader and more diffuse pairs; and those at forty-five degrees, of one very diffuse arc in each quadrant. The flightless feathers, on the other hand, gave two complete circles of considerable breadth, and one very weak pair of arcs corresponding to the vertical set. It is believed all circles obtained from the normal feather are produced by the flightless variety, but due to not being localized into short arcs, are too weak to record on the film.

From the patterns it is clearly evident that the mechanical difference in the feather lies in the degree of fibering, or alignment of the micelles. In the normal feather, the structural units are laid down in regular order like a bundle of sticks or the bricks in a wall, with corresponding axes oriented parallel to one another. In the abnormal and brittle feather the units are thrown together in a pile, with only a trace of orderliness apparent. The normal feather gives a fibre diagram; the abnormal virtually a powder pattern. This great difference in structure of the feathers seems ample to account for the observed variation in strength. It is easy to see that much more effective intermolecular forces might be brought into play by the regular arrangement of parts than by the random order of the "flightless" structure. The sharpness of the arcs in the direction parallel to the long axis of the normal feather in comparison with the broad arcs at right angles shows the micelle to be very long with respect to its breadth, a fact consistent with the fibre structure. The micelle lies with its long dimension parallel to the length of the feather.

Discussion

The relation of organic to mineral matter in bones affects their brittleness. The mineral matter of the bones of young animals is not as high as later in life. The bones are, therefore, more susceptible to bending without breaking. If the total phosphorus is an index of the amount of mineral matter, then the defective feathers have a higher mineral matter to organic matter ratio, which may result in the brittleness of the defective feathers.

Sullivan's method for estimation of cystine depends upon (1) reduction of cystine to cysteine, and (2) to the presence of the groups —SH, —COOH,

and —NH_2 in close proximity. If for any reason these groups are altered, the cystine content would read low. These groups were not affected when pure cystine was hydrolyzed in the same manner as the feathers. With more cystine present in the normal feathers than in the defective feathers, there is greater possibility for repeated double peptide linkages between the alpha amino nitrogen and the free carboxyl group, giving a longer chain. This could account for the X-ray patterns showing long micelle structure.

Summary

1. Chemical analyses show cystine sulphur to be 22.7 per cent higher and phosphorus to be less than one-half as abundant in the normal feather as in the flightless. Total sulphur and nitrogen in both types were the same.

2. X-ray analyses show the normal feathers to be well fibered while the defective feathers are fibered only to a slight extent. The micelles of the normal feather are very long and narrow, and lie parallel to each other and to the feather.

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Baking Tests for Wheat Varieties

THE problems of the plant breeder do not end in the field. He must not only produce a variety that has satisfactory growth habits, resistance to disease, and ability to mature a bumper crop in a given time, but he must produce a crop that has desirable economic qualities. In the case of the wheat breeder this is an unusually difficult problem, because the final test of a wheat variety is the loaf of bread which can be baked from the flour made from it. Field performance is of little value if the flour which comes from the mills produces dough lacking necessary baking qualities or a loaf of poor texture or flavor. This final test of the wheat-breeder's "cake" cannot be made until a desirable selection has passed through several generations because an appreciable quantity of flour is necessary to bake a loaf, and one or a few wheat plants will not furnish adequate test material. Only at the end of the third or fourth generation can enough wheat be obtained to undertake milling and baking tests, and if these are unsatisfactory much of the time and effort expended up to this point may be wasted.

The testing of wheat varieties has progressed a long way since C. E. Saunders "chewed his way" through some hundreds of samples to select the Marquis wheat, by that means making a rough estimate of its gluten content and possible baking qualities. Today there is an imposing array of test machines and processes for testing many features of the flour. A useful bibliography of publications regarding these tests has been prepared by the Imperial Bureau of Plant Genetics. This deals in detail with these various tests, presenting a brief discussion of the principles on which they operate, an evaluation of their usefulness to the wheat breeder, with especial emphasis on those tests which are suitable for use with a small sample of flour. The bibliography occupies 68 pages; it was published January 1, 1934, by the School of Agriculture at Cambridge, England.

THE PHYSICS AND CHEMISTRY OF LIFE

A Review

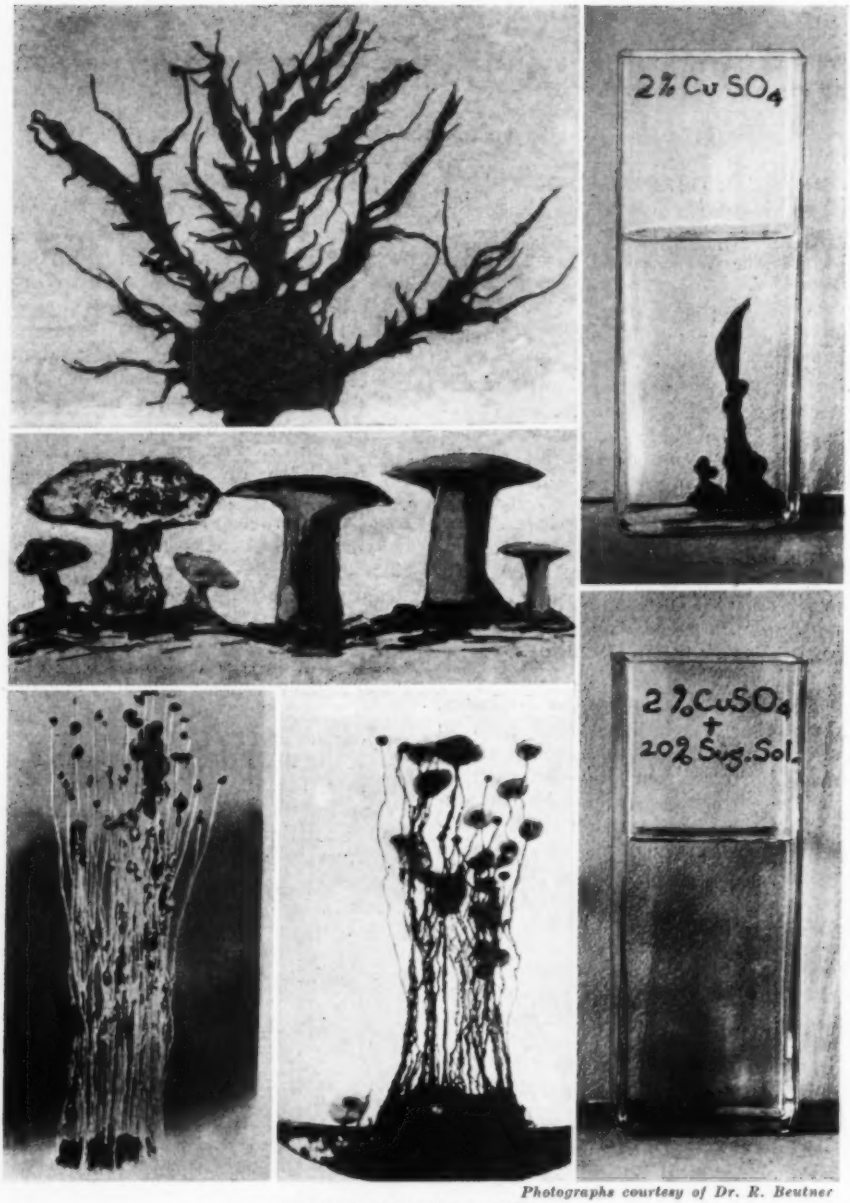
PHYSICAL CHEMISTRY OF LIVING PROCESSES, *by* R. BEUTNER, M. D., Ph. D., Professor of Pharmacology, School of Medicine, University of Louisville. 337 pages. The Williams and Wilkins Company, 1933.

TO use the author's own words, "Unfortunately even the possibility of attacking truly vital problems by physico-chemical methods is not recognized by many. . . . However, even if the synthesis of living organisms should remain impossible, the imitation of the majority of the single phases of life processes will result in a control over man's own existence to an extent unknown at present. In order to evaluate the importance of this development, we should look upon it as an outstanding event in the history of the earth, or of mankind."

As the above quotation indicates, the author attacks his subject with an open, unprejudiced mind which is remarkably free from ultra-conservatism and which succeeds admirably in conveying the due importance and necessity of a study of physico-chemical principles in a solution of the problems involving life processes. Throughout the book will be found applications of the facts and information supplied by such important physico-chemical principles and properties as the First Law of Thermodynamics, Osmosis, Electro-endosmosis, Donnan's Membrane Equilibria, Swelling and Shrinking of Colloidal Particles, Surface Tension, Adsorption, Laws of Chemical Equilibrium (such as the Law of Mass Action, Solubility Product, etc.), X-Ray Diffraction, Double Refraction, Liquid Crystals, Absorption Spectra, and a rather elaborate and extended application of the Theory of Concentration Cells and the Potentials of Phase Boundaries. All of these, and more, are applied in an effort to prove their importance and necessity in any successful effort to account for life processes on a purely natural basis devoid of any hypothetical "vital" influence, so often assumed to be a prime requisite in biological problems. The author himself realizes that only the merest beginning has been made in a very important line of investigation and that the possibility of further avenues of attack are many and varied. He says that "Life, therefore, in spite of all its complexity, seems to be no more than one of the innumerable properties of the compounds of carbon. Thus we realize that our knowledge of organic chemistry is just in its infancy."

The author divides his subject into three main divisions, called "Attempts at Approach." The First Attempt at Approach involves Membranes, Osmosis and Related Forces. The Second Attempt at Approach concerns Life Processes as Related to Crystallization and Surface Forces, while the Third Attempt at Approach involves Electrical Currents in Tissues and Their Relation to Life Processes. In each of these "Attempts at Approach" the author deals with the problem in the following manner. First he arranges artificial models which reproduce phenomena considered peculiar to living organisms; second, he studies the physical laws upon which the operation of the artificial model is based; third, he applies these physical laws to biological problems; and finally, on the basis of the experience thus gained, he attempts to extend the experiments with the models to other biological problems.

Throughout the book the author emphasizes the probability that all



Photographs courtesy of Dr. R. Beutner

"LABORATORY PLANTS"

Figure 4

At the left are shown various osmotic structures resembling living organisms. These are formed by floating fluids of different osmotic pressures upon each other. At the top is shown a structure resembling a water plant and below it a group of "mushrooms." The artificial structures below these, somewhat resembling seaweed perhaps, show what Laduc calls "end organs." At the right are shown the "plants" produced in a solution of copper sulphate and the "inhibition" of this growth when a sugar solution is added. A study of the physio-chemical laws governing the production of such forms may throw light on some of the laws governing the growth of organisms.

life processes can be duplicated with suitable physical models and that the hypothesis of a "life force" is not necessary in a study of such processes. In this connection his discussion of the experiments of H. S. Jennings with drops of chloroform are interesting. The author shows that a drop of the latter chemical, which is supposedly devoid of any "vital force," has the property of food selection in a manner identical with that possessed by lower forms of life, such as the Amoeba. The chloroform rejects such substances as glass, sand, dirt, wood, gum arabic and chlorate of potash, while shellac, paraffin, styrax, hard Canada balsam, and various other substances are accepted. This "power of choice," supposedly evidence of a rather highly developed mind, may in this instance be reduced to a matter of chemical solubility and surface tension.

The book concludes with a discussion of artificial parthenogenesis, mitogenetic radiation and cerebral activity. The Appendix consists of a more thorough account of some of the physico-chemical principles employed in the main portion of the book with emphasis on some of the newer investigations in connection with them.

As an approach to a new and important field of investigation, this book is naturally not above criticism, for it is inconceivable that any first attempts of this nature into such a complexity of phenomena as are involved in life processes should be without inherent flaws. For example, the statement which the author makes relative to the non-applicability of the Second and Third Laws of Thermodynamics to biological problems seems hasty and ill-advised, especially since the author, in another but similar connection, points out that "the reason given for the impossibility of spontaneous generation was simply that so far nobody had observed it. But, such a negative inductive proof cannot be convincing!" Moreover, it seems improbable that the majority of physico-chemical principles would be applicable and a minor fraction not so. The question should undoubtedly be left open for further experimentation and discussion, particularly in view of the probability of an erroneous application of the laws, or insufficient data upon which to base these laws.

In conclusion it should be clearly indicated that although the pendulum of biological research has in the past swung too far in the direction of hypothetical life phenomena, supposedly only remotely connected with the laws of physics and chemistry, the danger of over-emphasizing the latter on the return swing is ever present. The author, realizing this possibility, points out that "whatever usefulness we may ascribe to purely physico-chemical research we should realize that these studies are naturally insufficient by themselves to approach our goal, the exploration of life processes. In this respect we may compare physico-chemical studies to the athletic exercises which a mountain climber performs before an ascent. Even though they may be indispensable he cannot reach the peak by doing them exclusively."

This book is most certainly a worth while effort, stimulating, interesting, and instructive. It should be read by every one interested in either chemistry or biology.

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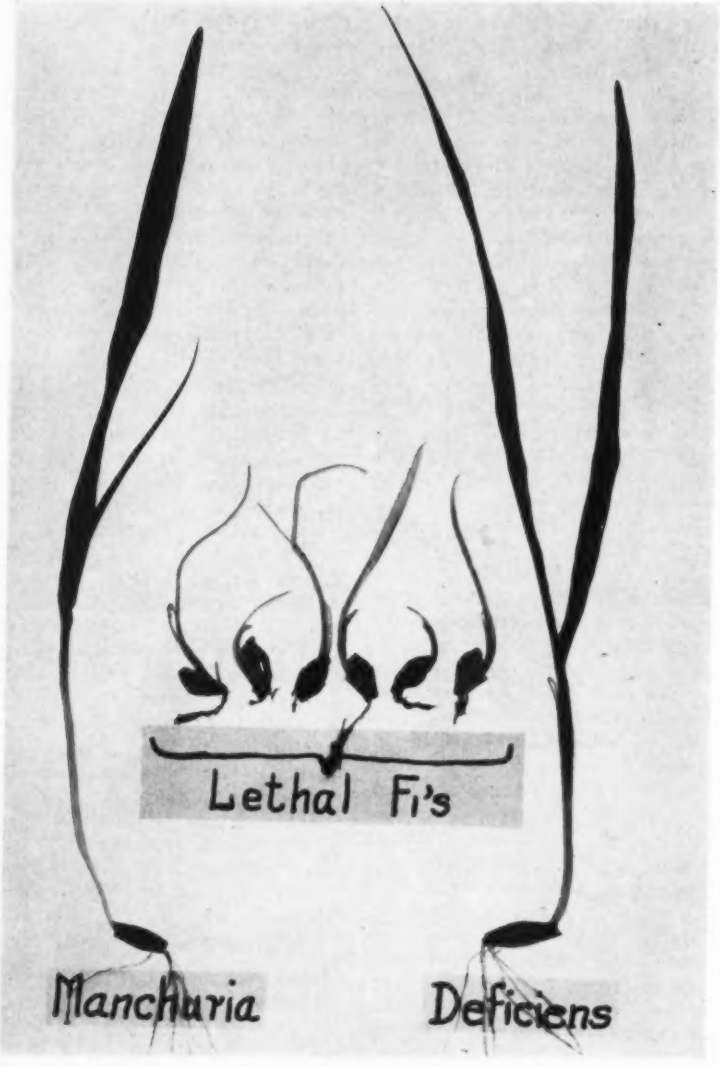

AN INTERVARIETAL CROSS PRODUCING A LETHAL PROGENY

Figure 5

Parents and lethal F_1 seedlings of an intervarietal cross in barley. The picture shows the relative development of the parents and F_1 seedlings at about the time when the hybrids die. All the hybrid seedlings produced by this cross have died. The lethality is explained as being due to complementary factors.

COMPLEMENTARY FACTORS IN BARLEY GIVING A LETHAL PROGENY

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IN 1926, a number of crosses were made with several barley varieties in connection with some genetic studies, the nature of which is of no interest so far as this paper is concerned. Only one of the crosses concerns us at the present time. This cross is one between Manchuria (C. I.† No. 2259) and Deficiens (C. I. No. 2225), both parents being pure lines. Nine seeds were obtained from this cross and were sown in the field in the spring of 1927. Some time later an examination of the row in which the crossed seeds were sown showed all of them to have germinated but subsequently to have died without emerging, whereas the parents and the F_1 hybrids from other crosses in adjacent and near-by rows emerged and all produced normal plants.

The occurrence of a lethal F_1 seemed rather singular in view of the fact that the cross was an intervarietal one. In order to check this matter, the same cross was repeated in two following seasons. The results were the same, as lethal F_1 seedlings were again obtained. During one of the two seasons, the crossed seeds were sown in the greenhouse, but their reaction under these conditions was no different from that in the field. Occasionally an F_1 grew until the plumule emerged a short distance, but in no instance did it develop farther. Approximately 60 crossed seeds were tested during these two seasons. Reciprocal crosses were identical in their behavior. Figure 5 shows the relative development of the parents and their F_1 hybrid at about the time when the hybrid died.

With respect to the crossed seed itself, it appears to be normal as far as could be determined by ocular inspection. The crossed seed is normal in size and just as large as that secured from crosses involving other varieties.

Having established the lethality of the F_1, it seemed desirable to test the case a little farther by proceeding on the assumption that the case involved complementary factors. In order to do this, each parent (Manchuria and Deficiens) was crossed with two other varieties, namely, Lion C. I. No. 923 and White Smyrna C. I. No. 910. The four possible crosses were made in 1932 and all gave viable F_1 plants the following year. (The cross Lion × White Smyrna gives a viable F_1, but it is not a critical one in the present analysis). Then by proper backcrossing, as for example the F_1 of Lion × Manchuria to Deficiens, one half of the F_1 seedlings from the backcross should be lethal and the other half viable. The backcrosses were made in 1933, and Table I gives the results obtained in the field in the spring of 1934.

The agreement with the postulated 50 per cent of lethal seedlings is satisfactory. Conditions for germination and seedling emergence were excellent in the spring of 1934, and therefore the number of emerged seedlings is probably unbiased by any disturbing

*Cooperative investigations between the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, and the California Agricultural Experiment Station.

†C. I. refers to accession number of the Division of Cereal Crops and Diseases.

influences during germination and emergence.

The seedlings of the F_2 generation of the crosses Lion × Manchuria, Lion × Deficiens, White Smyrna × Manchuria and White Smyrna × Deficiens gave no lethals as, of course, was expected.

The parents (Manchuria and Deficiens) seem to be unaffected by the factors which when brought together give a lethal F_1. Manchuria is a commercial variety and is grown in the upper Mississippi Valley. Deficiens is not grown commercially in the United States.

In summing up then, the data support the conclusion that the lethality of the F_1 of the cross Manchuria × Deficiens is due to complementary factors.

TABLE I.—Results of Backcrosses Made in 1933.

Backcross	Number of backcrossed seeds sown	Seedlings viable	Seedlings lethal	Expected viable or lethal
(Lion × Manchuria F_1) × Deficiens	88	47	41	44.0 ± 4.7*
(Lion × Deficiens F_1) × Manchuria	47	20	27	23.5 ± 3.4
(White Smyrna × Manchuria F_2) × Deficiens	87	43	44	43.5 ± 4.7
(White Smyrna × Deficiens F_1) × Manchuria	77	39	38	38.5 ± 4.4
Total	299	149	150	149.5 ± 8.6

*Standard errors.

Evaluating Heredity and Environment

NATURE AND NURTURE, by LANCELOT HOGBEN. W. W. Norton & Co., 1933, 144 pages. $2.75.

THE book is a valuable contribution towards our understanding of the rôle of heredity and environment in living organisms, particularly in man. The attitude of the author is unprejudiced by political motives, and his treatment of social phenomena is handled with the same scientific honesty as the purely "technical" aspects of the probable distribution of recessives and dominants in man and the statistical methods of determining it on the basis of random mating. In a way it is regrettable that Professor Hogben borrowed Galton's title, not only because of its alliteration and jingle, but primarily because stating the problem in terms of this misleading opposition helps to perpetuate the very fallacy which the book tries to combat. In the first chapter Professor Hogben summarizes the content of the problem very concisely when he says that "no statement about a genetic difference has any scientific meaning unless it includes or implies a specification of the environment in which it manifests itself in a particular manner. Characteristics of organisms are the result of interaction between a certain genetic equipment inherent in the fertilized egg and a certain configuration of extrinsic agencies which include the conditions of life in the uterus and the external environment in which social existence is carried on."

In recent years many writers on genetics have piled up volumes on the artificial and misleading question of "heredity *vs.* environment," all handled in the spirit of high school students debating the issue "Who was the greater man, Washington or Lincoln?" Surely it is about time that we realized that these two arbitrary components of forces responsible for the formation of a character are in-

separable in reality. Any examination of the concept of the gene must force upon us the conclusion that its very definition involves three components, namely: the gene matter, situated on the chromosome; the other genes, that is, the genetic environment; and finally, what we term the external environment. Such a classification is an arbitrary isolation for convenience of analysis. In practice the "character" is the produce of organically linked reactions in which all of these forces are involved. It is impossible to isolate in actuality the effects of one component from those of another under given conditions. True enough, by keeping the gene matter and the genetic environment constant and by varying the external environment we may be enabled to study the effects of the change upon the character under examination. Here again, under the new conditions, the developmental processes form an inseparable, dynamic system even though certain components may be slightly modified. The very concept of the gene for vestigial in *Drosophila melanogaster* implies a gene particle, situated in the right arm of Chromosome II, which in the presence of a specified genic make up and under a given external environment will produce vestigial wings. We know very well that under a changed external environment, such as a different temperature, or in the presence of genetic modifiers, the appearance of the character will vary. In man the sitution is even more flexible, because the human enviroment contains many additional factors:—social, educational, psychologic, hygienic, etc., all relatively speaking within our control. Thus it is possible for a man to carry the gene for a given character and yet inhibit the appearance of that character by a suitable manipulation of the controllable environment. The converse is also true, namely that without possessing a gene for a given defect or advantageous capacity, the respective character may still be produced by a particular environment. Hence any analysis of inheritance in animals and *particularly in man* must carefully account for all the factors operating within the external environment in addition to a rigid control over the genetic one. Incidentally the latter is impossible in an outbred animal such as man.

Although all the problems mentioned here are fully recognized by Professor Hogben, they are not given due consideration in reference to specific social, psychologic and economic instances in human society. At the present time particularly, there is a crying need for such elucidation. Eugenic philosophers often commit the grave error of separating the component factors in the concept of the gene and of stressing the purely genic aspect of it and of advancing remedies such as sterilization, racial purity and superiority and similar slogans. Their scientific shortsightedness and distortion may be taken advantage of and put into practice by politicians, as for example in Germany, where their application expresses itself in untold misery tc thousands of innocent human beings. The aptitude of some eugenists may also aid in blinding the population to the need of social change as a remedy for the evils they decry. Exposing these confusions and aiding in their clarification is clearly within the sphere of Professor Hogben's work. Unfortunately it is not given much attention beyond a few caustic remarks.

In the chapters on Random Mating, Consanguineous Parentage, Genetic Analysis of Familial Diseases, and Interdependence of Nature and Nurture, Professor Hogben deals exhaustively with a mathematical analysis of the distribution of recessive and dominant traits in a population with respect to frequency of homozygotes and heterozygotes, and with the effect of consanguineous marriage upon the dis-

tribution of specific characters in man. The book as a whole forms an indispensible guide to anyone concerned with human heredity. Many biologists may find the mathematical treatment a bit difficult, but, as the author points out, statistical treatment is the best tool available at the moment on account of experimental limitations. The method is also very helpful in revealing complexities and further roads to follow. The dangers of the method are clearly pointed out as tending to "conceal assumptions which have no factual basis behind an impressive facade of flawless algebra." The very fact that Professor Hogben, who has had such extensive recourse to the statistical method and who has made contributions to it, is aware of its limitations should be encouraging to those who fear being led astray by attractive formulae. In spite of the limitations mentioned above, the book is an essential prerequisite for students of human biology and genetics.

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Rhesus Anatomy

THE ANATOMY OF THE RHESUS MONKEY: Edited by Carl G. Hartman and William L. Strauss, Jr. Pp. ix-383, 122 figures. The Williams and Wilkins Co., Baltimore, 1933.

A USEFUL book consisting of contributions from specialists in comparative anatomy. The work is an excellent example of what can be accomplished by a cooperative endeavor on the part of authors, editors and publishers to supply a deeply felt need, although it "was not designed as a textbook in the ordinary sense, but rather as a handbook, presenting as it does in eighteen chapters the independent researches of as many individuals. The book is to be judged as a pioneer, since it represents the first comprehensive anatomy of an old world monkey. A certain lack of the balance that should characterize a textbook was inevitable. Any attempt to imitate for the monkey the textbooks of human anatomy, which have become standardized after hundreds of years of research, would have been futile."

The manner in which each anatomical system of the body has been described and illustrated by comprehensive drawings and tables makes the book a very useful guide for dissections in comparative anatomy, for research students of behavior, and for any others who utilize the monkey in laboratory procedures.

In addition to the systems usually described in works on anatomy (skin, skeletal, vascular, etc.) there is a chapter on the identification and classification of Macaques, by Gerritt S. Miller of the U. S. National Museum, and another by Adolph H. Schultz of Johns Hopkins, on growth and developmental phenomena. A valuable appendix describing the housing, care, food, etc., of monkeys is presented by Carl G. Hartman of the Carnegie Institution of Washington.

A large amount of research is needed on the various details of comparative anatomical organization, which statement applies to all systems of the body, and to the nervous system in particular, and the present volume with its comprehensive survey of the subject should stimulate and direct many additional investigations. The subject matter is indexed.

This book will undoubtedly be consulted freely by many active workers in the biological sciences.

N. D. C. LEWIS
St. Elizabeth's Hospital

THE INCIDENCE OF UTERINE CANCER IN JEWS AND GENTILES

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THE relative incidence of cancer of the uterus in Jews and Gentiles has for some years been a matter of interest to biologists and students of the cancer problem. It forms the central theme of a very stimulating discussion by Sorsby.† Tending to discredit the racial factor as the major difference between the two types, Sorsby advances evidence "for considering the low incidence of cancer of the uterus, not as the result of racial immunity but as the result of environmental factors operating in the life of Jewish women."

It is undoubtedly true that no final decision as to the relative importance of the racial and of the environmental factors involved can be made until carefully prepared pedigrees supplemented by accurate information on the observance or non-observance of orthodox Jewish customs are available. In the meanwhile, however, it has appeared worth the effort to conduct a survey study of the incidence of uterine cancer in various hospitals in the United States.

It is also undoubtedly true that in this country the relaxation of orthodox Jewish customs is greater than in certain European centers of Jewish population. The social line drawn between Jew and Gentile in such cities as Vienna, Amsterdam, Lodz, Leningrad, Warsaw, and Budapest cited by Sorsby is undoubtedly more distinct than in the cities of Chicago, Philadelphia, Cleveland and New York. Data derived from these cities will be included in the present communication.

Sorsby's data are based on vital statistics derived from published reports. In any such data certain factors of error must be admitted. There is the question of accuracy of diagnosis and in some cases variable criteria for the religious classification. On the other hand the numbers are large and there is no *a priori* reason apparent why the sources of error should not be distributed by chance approximately equally between Jews and Gentiles.

The data presented in the present communication also have their weak points. The classification of Jews and non-Jews can only be as careful and as exact as the nature of the hospital records will permit. The numbers are, of course, not as extensive as are those given by Sorsby. On the other hand the accuracy of diagnosis is probably as great as one can expect at the present time. The data are also gathered for a five-year period, 1927-31, which is short enough and a modern enough period to insure something approximating uniformity in procedure within any given institution.

Material and Results

One of the ways in which the relative incidence of uterine cancer in Jews and in Gentiles can be compared is by determining for any given hospital (a) the total number of patients admitted in a fixed period, (b) the total number of Jewish patients admitted in the same period, (c) the percentage of total patients which are Jewish, (d) the total number of uterine cancers recorded in the same hos-

*The thanks of the authors are due to the various institutions mentioned in this note and to the individual officials of those and other institutions who assisted materially by collecting desired information or by offering us graciously the opportunity to do so.

†Sorsby, M., *Cancer and Race*, Wm. Wood & Co., Baltimore, pp. vii + 120.

pital during the same period, (e) the number of these that occurred in Jewish patients, (f) the percentage which this represents. The difference between the percentage of total patients that were Jewish and the percentage of uterine cancers that occurred in Jews will give a measure of the relative incidence of this general type of cancer in Jews as compared with Gentiles.

Definite figures have been obtained by the coöperation of eighteen general hospitals* and are given in Table I.

Another basis for comparison of the incidence of uterine cancer is provided by the study of the records of five Jewish hospitals.†

It was found (Table II) that the incidence of Jewish patients among the cases of cancer of the breast was much higher—69.20%—than was the incidence of Jews among the cases of cancer of the uterus—36.18%.

Such data as these show clearly the fact of low incidence of uterine cancer in Jews in spite of, rather than because of, any possible inaccuracies in the way in which they are collected. They thus become doubly convincing.

A more detailed study of 598 cases of uterine cancer has been carried out. These are derived from the following hospitals: Memorial‡, Mount Sinai, Beth Israel, Jewish and Montefiore of New York; Jewish of Philadelphia; Mount Sinai of Cleveland; and Michael Reese of Chicago. Of the total, 452 are classed as Gentile and 146 as Jewish. The age distribution by per cent of these cases is shown in Figure 6*A*.

There is clearly a difference in age distribution in the two groups. This is an interesting point since it suggests that a racial factor may be operative in the two cases. Racial differences in the age of incidence of cancer have long been recognized in laboratory mammals. The transference to humans of principles observed in such material is admittedly of doubtful propriety. No claims are made therefore that the results are

TABLE I. Study of cancer of the cervix and uterus. Comparison of Jews among cases of cancer of the cervix and uterus with total admissions in eighteen general hospitals.

HOSPITAL	PATIENTS			CANCER CERVIX AND UTERUS		
	TOTAL	JEWISH	% JEWISH	TOTAL	JEWISH	% JEWISH
(a)	12,345	733	5.95	108	0	0
(b)	29,013	1,086	3.74	72	1	1.39
(c)	28,160	939	3.30	68	0	0
(d)	18,106	4,549	25.12	43	6	13.95
(e)	16,130	447	2.77	42	0	0
(f)	28,980	4,267	14.72	84	4	4.76
(g)	1,891	43	3.08	97	3	3.09
(h)	80,998	8,413	11.72	148	8	5.41
(i)	23,063	13,348	57.85	27	14	51.85
(j)	9,845	1,861	18.91	28	7	25.00
(k)	2,000	15	.75	3	0	0
(l)	13,888	12,790	95.42	5	4	80.00
(m)	16,328	231	1.41	60	0	0
(n)	24,957	19,666	78.79	28	20	71.42
(o)	15,425	11,208	72.31	11	8	72.72
(p)	36,943	8,128	21.89	53	23	43.39
(q)	270,966	29,170	10.77	545	19	3.49
(r)	2,199	465	21.15	424	9	2.11
TOTAL	972,252	111,447	19.48	1,648	156	6.84

TABLE II. Study of cancer of the cervix and uterus. Comparison of Jews among cases of cancer of the breast and cancer of the cervix and uterus in five jewish hospitals used in study.

HOSPITAL	CANCER CERVIX AND UTERUS			CANCER BREAST		
	TOTAL CASES	JEWISH CASES	PER CENT JEWISH	TOTAL CASES	JEWISH CASES	PER CENT JEWISH
(a)	16	5*	31.25	49	46	93.88
(b)	21	12	57.14	50	25	48.08
(c)	39	9	18.75	70	22	31.43
(d)	69	40	57.97	129	107	82.94
(e)	34	6	17.65	146	110	74.32
TOTAL	199	72	36.18	448	310	69.20

*Only one of these five cases was definitely identified as being Jewish, but the four who were doubtful were included in order to obviate any question of the results. With the four cases omitted the percentage of Jewish cases in (a) would be 6.25, and the percentage of Jewish cases in the total would be 34.17.

All of the Jewish hospitals cooperating in the study were asked for their statistics on breast cancer, but the other two did not reply to our letter.

*The hospitals coöperating were as follows: Chicago—Chicago Memorial, Ravenswood, Swedish Covenant, St. Mary of Nazareth, Lutheran Deaconess, Frances Willard; New York—Cancer Institute, Bellevue, Joint Diseases, Swedish, Polyclinic, Beth David, Ridgewood, Bronx, United Israel Zion, St. Peter's; Philadelphia—Lankenau, Jeanes. With the exception of the Jeanes Hospital which did not open until 1928 the figures represent the hospital admissions for the five-year period 1927-1931.

†These hospitals are the Montefiore and Beth Israel of New York, Mount Sinai of Cleveland, Jewish of Philadelphia and Jewish of Brooklyn.

‡Dr. L'Esperance of the Cornell Clinic has kindly contributed to these results the data derived by her from a study of the records of the Memorial Hospital, New York, for the period 1918-26.

conclusive. It merely seems that they are of sufficient importance to merit further study.

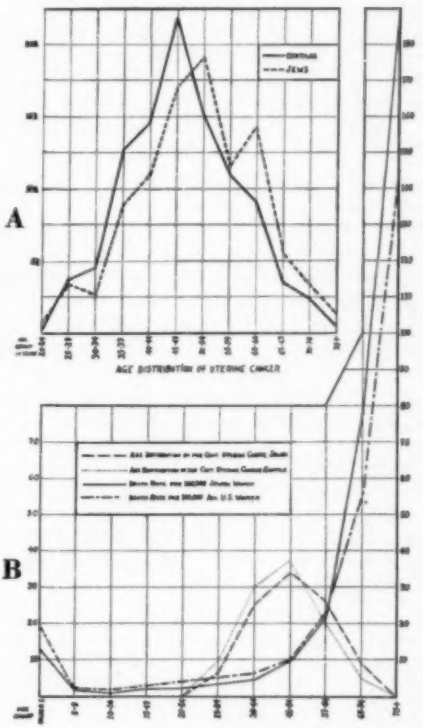
Another interesting comparison can be made between the death rate of Jewish women in New York City with the death rate per thousand for women in the United States. The latter figures are based on the 1923 Census report. The data on Jewish women in New York are taken from the "Jewish Communal Survey of Greater New York" published in 1928 by the New York Bureau of Jewish Social Research. The survey was made in 1925. In Figure 6*B* these data are compared with the age distribution of Jewish and non-Jewish cases of cancer of the cervix taken from the records of seven Jewish and one general hospital.

The results support the data already given in Figure 6*A* and suggest the possibility that Jewish women have constitutional factors contributing to relative longevity as compared with the female population as a whole.

In view of these data it would appear that the conclusion reached by Sorsby that ". . . variations in the rates observed for the Jews of the different cities make a hypothetical racial factor quite unsatisfactory as the possible cause for the different incidence of cancer . . . among Jews" is not convincing. If one remembers the great variables in diagnosis and in vital statistics which are introduced when data of various nations are compared it is doubtful whether Sorsby's statement that "A racial factor should give a uniform rate and not one varying hectically from city to city" is justified.

When the League of Nations attempted to compare data on treatment of a certain type of cancer in a small number of leading European hospitals it found such great variation in methods of diagnosis and in records that it concluded that the data were not fairly comparable.

While in the present study such variables have not been completely eliminated they have been reduced to a minimum by careful study of the methods of diagnosis and records employed. Only those data that appear to be free from avoidable inaccuracies have been included. Thus while the



AGE AND RACE DISTRIBUTION OF CANCER

Figure 6

Above (*A*) is shown the percentage distribution of age groups of cases of uterine cancer in Jews and Gentiles, showing its appearance later in life in the former group. Below (*B*) is shown the death rate per hundred thousand of Jewish women and of all women in the United States and the age distribution by per cent for uterine cancer of all the cases in Gentile women and in Jewish women in this study. While the numbers are not large enough to base final conclusions on, as far as they go the data strongly suggest that uterine cancer is less common in Jews than in Gentiles and that it tends to occur later in life.

numbers are small it is hoped and believed that the cases included are as nearly accurately diagnosed and classified as it is possible for them to be under the existing system.

In view of this fact and on the basis of the above figures it would appear that cancer of the uterus is significantly less frequent in Jews than in Gentiles and that it occurs at a later period in life. The possibility of the existence of a racial factor cannot, therefore, as yet be considered eliminated.

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

DISEASES PECULIAR TO CIVILIZED MAN, *by* GEORGE CRILE, M. D. Pages 427, index, bibliography, and 41 illustrations. Price $5.00. The Macmillan Company, New York, 1934.

When we do things to natural barriers to survival we do not stop people from dying—we only make them die later of things they would not have died of in youth.

DAYLILIES, the Wild Species and Garden Clones. Both Old and New, of the Genus Hemerocallis, *by* A. B. STOUT, Ph. D. Pages 119, index, appendix, and 36 illustrations. Price $3.00. The Macmillan Company, New York, 1934.

THE MYXOMYCETES, A Descriptive List of the Known Species with Special Reference to Those Occurring in North America, *by* THOMAS H. MACBRIDE and G. W. MARTIN, State University of Iowa. Pages 339, XX Plates, appendix, bibliography and index. Price $6.00. The Macmillan Company, New York, 1934.

Perhaps the fact that we have here a virtually virgin field for genetic research impelled the publishers to nominate this book for review in the JOURNAL.

THE CHANCES OF MORBID INHERITANCE, Edited *by* C. P. BLACKER, M. C., M. A., M. D., M. R. C. P. General Secretary of the Eugenics Society (London). Pages 449, illustrations, and index. William Wood and Company, Baltimore. 1934.

CIVILIZED LIFE. The Principles and Applications of Social Psychology, *by* KNIGHT DUNLAP, Professor of Experimental Psychology in the Johns Hopkins University. A Revision and Enlargement of Social Psychology, 1925. Pages 374, index. The Williams & Wilkins Company. Baltimore, 1934.

THE INFLUENCES OF HEREDITY ON DISEASE, *by* L. S. PENROSE, M. A., M. D. Buckston Browne Prize Essay, 1933. Pages 80, index. M. K. Lewis & Co., Ltd., London, 1934.

A very considerable subject well treated in small compass.

HORTUS, A Concise Dictionary of Gardening and General Horticulture, *by* L. H. BAILEY and ETHEL ZOE BAILEY. Pages 652. Price $5.00. The Macmillan Company, New York, 1930.

A standard work reissued at a new low price, which may well add to its value through a wider "circulation."

THE CASE FOR STERILIZATION, *by* LEON F. WHITNEY, Director, American Eugenics Society. Pages 309, bibiography, and apendices. Price $2.50. Frederick A. Stokes Company, New York, 1934.

Permanent Birth Control advocated for ten per cent of the population of the United States.

GENEALOGY OF SEX, Sex in its Myriad Forms, from the One-celled Animal to the Human Being, *by* CURT THESING, M. D. Translated from the German by Eden and Cedar Paul. Introduction to the American edition by Smith Ely Jelliffe, M. D. Pages 286, index. Price $5.00. Emerson Books, Inc., New York, 1934.

A book which all who venture to express opinions on sex could well consider as a sort of prerequisite to having any views on the subject.

ANOMALOUS SEGREGATION OF A TRIPLOID TOMATO

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LESLEY[7] reported that numerous attempts to obtain seed from self-fertilization of a triploid tomato were all unsuccessful. Defective pollen appears to be the chief cause. Diploid ♀ × triploid ♂ produced seed "very sparingly" while seed was "readily obtained" from the reciprocal cross. In the latter, the mean number of viable seeds per fruit was about 4, as compared with about 50 in the diploid of the same variety, Dwarf Aristocrat, when selfed. M. M. Lesley[8] showed that in 94 pollen mother-cells of a triploid tomato the chromosomes assort at random to the four daughter nuclei, the distribution being as shown below.*

East[2] notes that "When the records of the studies of the progenies of triploids are listed, they prove to be a variable lot." He is of the opinion that in addition to the mechanism of gene by gene pairing and segregation there may be "a fundamental mechanism for bringing complete genoms into gametes at meiosis . . ."

The triploid tomato progeny here recorded, being composed exclusively of tetraploids, is far more anomalous than any of those cited by East. The original triploid plant is anomalous in its origin also. The two anomalies should, however, be considered independently, as the evidence regarding each is independent, and there is no proof that they are causally related.

Material and Methods

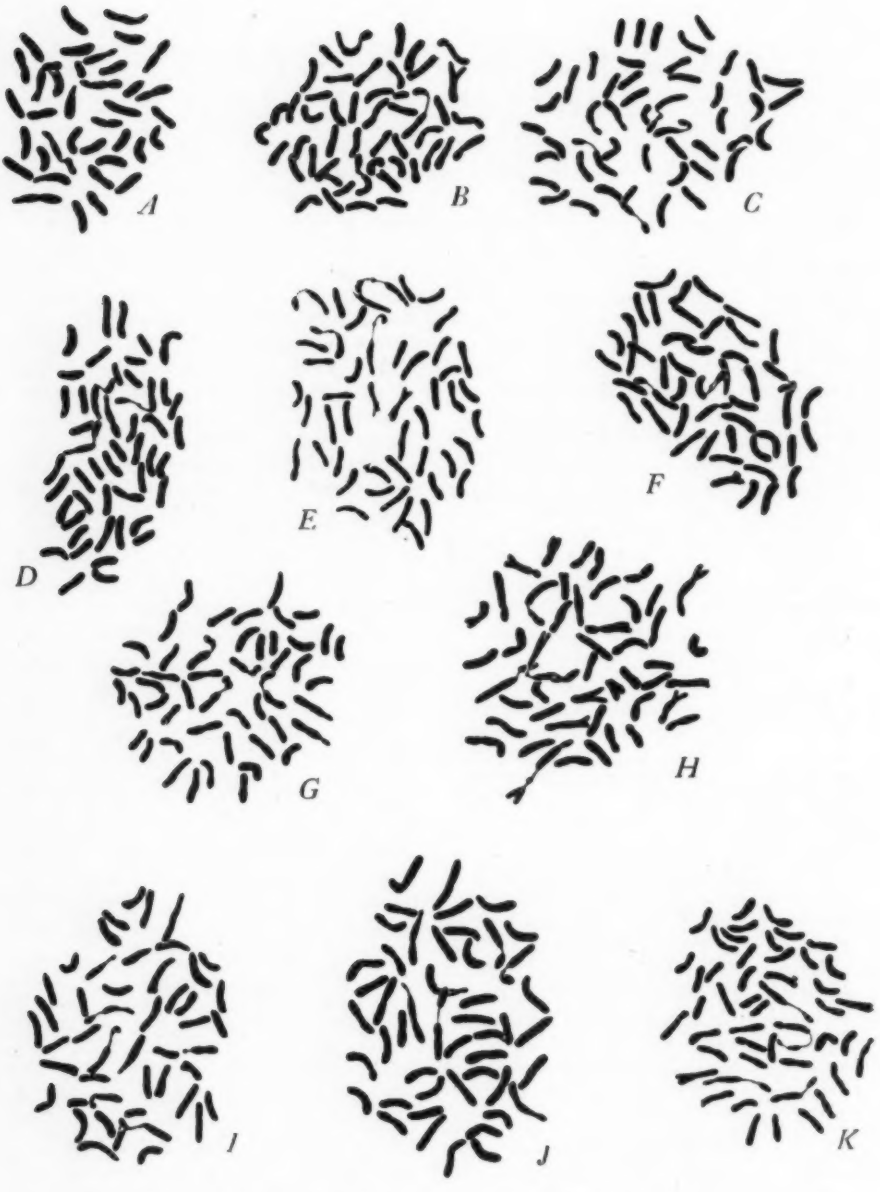
As recorded by Jorgensen[6] the triploid tomato here described arose from a stock of *Solanum Lycopersicum* on which a scion of *S. luteum* had been grafted. This plant was decapitated and the adventitious shoots arising from the callus tissue were propagated by Mr. M. B. Crane of the John Innes Horticultural Institution, London, to whom I am indebted for the material. Among these adventitious shoots was the one triploid, and from it a number of plants were obtained by cuttings. The first flowers were produced in March, 1926, and the first fruits late in 1927. The two fruits then produced contained 22 seeds, of which 11 germinated and produced mature plants.

Root tips of the triploid plant 5^2, and of its eleven progeny, $28/1_1$ to $28/1_{11}$, were fixed in Medium Flemming, embedded by the ordinary paraffin method, cut at 12 microns and stained by Newton's iodine gentian-violet method. Flower buds were fixed by Kihara's method, Carnoy 6:3:1 for one minute followed by Medium Flemming, and were similarly prepared and stained by Mr. Stanley G. Smith, to whom I am greatly indebted for assistance in the later stages of this study.

Observations

Figure *7A* illustrates the 36 somatic chromosomes of triploid plant 5^2. Eight cuttings were taken from different parts of this plant and all found to be chromosomally similar. The number 36 had earlier been determined for other cuttings of the same plant by Crane (unpublished)

*Number of Chromosomes	12	13	14	15	16	17	18	19	20	21	22	23	24
Frequency	1	1	6	4	10	23	22	13	4	7	0	2	1



CHROMOSOMES OF TRIPLOID AND OF ITS TETRAPLOID PROGENY

Figure 7

At *A* are shown the somatic metaphase chromosomes of the triploid parent plant, 5°. *B-K* show comparable chromosomes of ten of its eleven tetraploid progeny, magnification 2300 X.

TETRAPLOIDS FROM A TRIPLOID

Figure 8

At the right is shown the triploid plant 5^2 and at its left three of the tetraploid progeny plants. As is usually the case this plant was virtually sterile, but one branch produced twenty-two seeds from which eleven plants were raised. All of the progeny were tetraploids. The production of tetraploids by selfing a triploid has not heretofore been recorded.

and Jorgensen. But where all previous illustrations show the somatic chromosomes of the tomato to be similar in size and form, very distinct differences are here demonstrated. One chromosome ("A") is particularly distinct, as it has two constrictions dividing it into three almost equal-sized segments, and one of these constrictions is often so sharp and the chromosome so attenuated in this region that the segment distal to it sometimes appears totally unconnected. From Winkler's[13] illustrations it appears probable that some of the extra chromosomes which he described were really these segments. In plant 5^2 this segment was never seen to be as far removed from the rest of the chromosome as it was in some of the progeny, and particularly in "rogue" tomatoes (Huskins and Crane[5]). Though all the chromosomes cannot be distinguished, there are, as far as can be ascertained, twelve different shapes or sizes, each represented three times in plant 5^2.

Figure *7B-K* illustrates the somatic chromosomes of the progeny of triploid plant 5^2, with the exception of plant $28/1_3$. The fixation of root-tips from this plant was not very satisfactory. The chromosomes were too contracted to permit differentiation of size or form. Two counts of 48 and one of 47 were made in the relatively unsatisfactory material, so that it may be presumed to have been similar to the others in having 48 chromosomes. Chromosome "A" can readily be determined to be present in quadruplicate in all the ten progeny plants illustrated. The relatively great polymorphism of this chromosome may, however, be noted.

Studies of meiosis were made chiefly on plant $28/1_1$. (Figure 9). Figure *9F* illustrates different types of quadrivalents found. A minimum of one and a maximum of five quadrivalents per nucleus were observed. One or two univalents were frequently present. The meiotic behaviour of this abnormal tetraploid

plant is therefore similar to that of the tetraploids described by Jorgensen which have arisen by direct somatic doubling. It differs from that of the tetraploids described by Lesley and Lesley[9] and by Lindstrom and Koos[11], in which 12 quadrivalents were frequently found. It is nearer to Lindstrom's[10] *S. pimpinellifolium* tetraploid, in which he reports the absence of quadrivalents.

Meiosis in the triploid 5^2 is similar at metaphase, as noted by Jorgensen, to that of the triploids derived from crosses of diploids and tetraploids which were studied by M. M. Lesley. The maximum number of trivalents found in one nucleus was seven.

Size differences between the chromosomes, though naturally less clear than at mitotic metaphase, are yet readily seen at the first metaphase of meiosis.

The eleven tetraploid progeny plants were all slightly abnormal in appearance. They varied considerably in fruitfulness and seed production. During the season of 1928 the total number of fruits produced by these plants and the number of seeds found in the larger fruits which were saved for seed production were as follows:

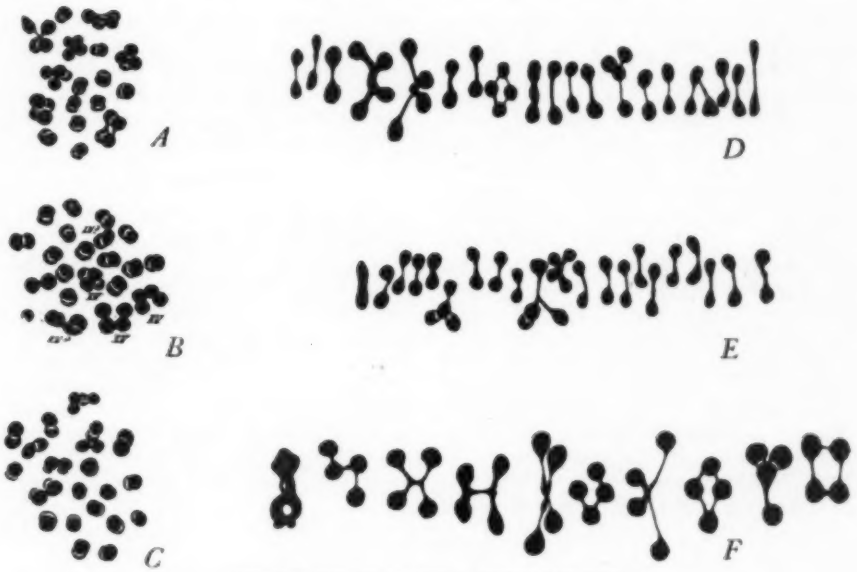
Plant	Number of fruits	Number of seeds per fruit
28/1	3	20, 44
2	4	9, 46, 9, 31
3	7	19, 15, 22
4	5	7, 31, 14
5	4	48, 63, 22, 50
6	3	49, 55
7	0	—
8	5	60, 16, 22
9	10	25, 12, 7
10	6	7, 42, 67
11	8	20, 23, 55

Under similar conditions of growth, normal diploid tomatoes of this variety may bear as many as 150 seeds per fruit. Sansome[12] reports an average of 115 seeds per fruit (nine fruits) in the diploid, and 21 (seventy-one fruits) in the tetraploid portions of nine plants of an experimental strain of tomatoes. Lindstrom and Koos obtained a total of fewer than 20 well-formed seeds from eighty to ninety fruits of a homozygous tetraploid derived from a haploid.

Discussion

As Jorgensen has pointed out, there is unfortunately no direct proof that the tomato stock on which the triploid shoot 5^2 arose was a diploid. The indirect evidence is, however, very strong. First, Mr. M. B. Crane, who produced it would certainly have noticed if the original stock had been anything but normal diploid, especially as he was at that time examining all his stocks carefully for "rogues" which are of very similar appearance in some respects to triploids. Secondly, it was the only triploid shoot obtained from this stock. Thirdly, it is *possible* that the fact of its progeny being very different in chromosome number from those of triploids obtained in the ordinary way by crossing of diploid and tetraploid may be related in some unknown way to its origin.

The mechanism by which tetraploid shoots arise in decapitated tomato plants has recently been studied by Lindstrom and Koos and by Mather (Appendix to Sansome[12]). It appears most probable from Mather's observations that tetraploid cells arise through decapitation stimulating large, highly vacuolized cells to divide, after which wall formation fails and the two nuclei later fuse. The somatic origin of a triploid is a far more difficult matter to envisage. It seems possible that it might arise through the formation of a hexaploid cell and somatic reduction of this. Somatic pairing has been found occurring by Gates[3] in Oenothera and by the writer[4] in nucellar tissue of *Matthiola incana*, though as far as I am aware no case of complete somatic reduction has ever been recorded. In *Drosophila melanogaster*, Bridges[1] has obtained haploid areas of tissue through the action of a gene causing somatic loss of chromosomes.



CHROMOSOMES OF A TETRAPLOID

Figure 9

A-C show polar views and *D-F* show side views of the heterotypic metaphase chromosomes from one of the tetraploid progeny of the triploid tomato. In Figures *D* and *E* the chromosomes are spaced out in drawing. In Figure *F* are examples of multivalent chromosome configurations selected from a number of cells. Magnification of Figures *A-E* 2300 X; of Figure *F* 2800 X.

Whatever the origin of the triploid, the occurrence of only tetraploid individuals in its progeny remains inexplicable. If in some way a tetraploid branch could arise on a triploid, the occurrence of only tetraploid progeny would be readily understandable, though their variability, especially, would remain unexplained. But no mechanism which would give a tetraploid cell somatically from a triploid has ever, so far as I am aware, been suggested. Further, as mentioned, eight cuttings were taken from different parts of this plant after it had fruited and all were found to be triploid. It seems just possible that in originating somatically this triploid may have acquired a chromosome constitution peculiarly inimical to the functioning of all but diploid gametes or the survival of all but tetraploid zygotes. M. M. Lesley, with whose observations those on the present triploid agree, found that in 94 pollen mother-cell second metaphase plates of her triploid tomato there were one with 12 and one with 24 chromosomes. That is, approximately one per cent of the pollen grains would be diploid. Since the two fruits found on plant 5^2 may well have had as many as 200 potential ovules each, the 11 seeds which grew represent less than 3 per cent of the total possible. But M. M. Lesley found, as have workers with other plants, that self-fertilization of a triploid normally produces mainly diploid progeny and that exact tetraploids are among the rarest of all the segregates. Plant 5^2 was almost certainly self-fertilized; it was the only tomato plant grow-

ing in its section of the greenhouse. Further, no tetraploids were being grown at the John Innes Institution at that time. The high fertility of this one fruiting branch—11 seeds per fruit and 50 per cent germination—especially as compared with Lesley's triploids, is very strongly against this suggestion of gametic and zygotic elimination. It favours the suggestion that some somatic change has occurred. It is possible that the fruitful branch may, through somatic doubling, have become hexaploid, and its functional gametes have been mainly diploid. It may be possible to evaluate this suggestion when further results are obtained by those now working on the cyto-genetics of polyploid tomatoes.

Whatever the mechanism by which this triploid produced only tetraploid progeny, it is clear, as emphasized by East, that seemingly illogical results may be expected to appear occasionally in genetic or cytological studies of triploids.

Summary

A triploid tomato shoot arose somatically from a diploid stock in the culture of Mr. M. B. Crane at the John Innes Horticultural Institution. The triploid plants propagated vegetatively from this shoot were highly sterile. Two fruits produced after nearly two years of cultivation contained 22 seeds, of which 11 germinated. All the 11 progeny plants were tetraploids. This is very different from any other triploid progeny recorded.

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A Glossary Of Technical Terms

Used In This Issue

GENETICS has developed so rapidly that many terms in common use in genetic literature are not yet incorporated in the dictionaries. Many people who are interested in heredity are bothered by such words, for which no definition can conveniently be found. For this reason, it is proposed to publish occasionally a glossary of terms which would not be readily understood and which are not to be found except in new unabridged dictionaries. It is realized that these definitions will probably not meet with universal approval and comments and suggestions will be welcomed.

BACKCROSS—Cross of a hybrid to one of the parental forms.

CHARACTER (a contraction of characteristic)—A term used, often rather vaguely, to designate any form, function, or feature of an organism. The Mendelian characters of genetics represent the end-products of development in which a definite gene, or genes, have a decisive effect. "The constant and unchanging thing, therefore, is the factor (gene) itself rather than the character, and the unity which Mendel observed lies rather in this underlying factor than in the visible, and perhaps variable, character which it produces."—Sinnott and Dunn.

DIPLOID—Having the normal paired chromosome arrangement found in somatic tissue, due to doubling of the primary chromosome complex at fertilization. See *Somatic*.

F_1—(Pronounced eff-one). The first filial generation. The offspring of a given mating.

F_2—The second filial generation. Produced by intercrossing or self-fertilizing the F_1. The inbred grandchildren of a given mating.

GAMETE—A reproductive cell of either sex; e. g. sperm or ovum.

HAPLOID—Having the reduced number of chromosomes, as in germ cells, as distinguished from the diploid or double number of chromosomes in normal somatic cells.

HETEROPLOID—An organism characterized by a chromosome number that is not a multiple of the basic haploid number.

HEXAPLOID—An organism characterized by having six times the basic haploid number of chromosomes.

MEIOSIS—The reduction divisions preceding the formation of gametes, in which the chromosome pairs separate, and the chromosome number is reduced to half the somatic number.

METAPHASE—The middle stage of cell division when the chromosomes are grouped in the equitorial plane.

MITOGENETIC RADIATION—Radiation believed by Gurvitch and others to emanate from some growing tissues.

MONOZYGOTIC—Originating from a single fertilized egg cell, which in the course of subsequent development has given rise (by fission) to two or more individuals. Twins (or triplets, etc.) of such origin are, barring mutations, genetically identical.

MUTATION—Where a heritable variation begins. A sudden variation in an inherited character.

PARTHENOGENESIS—The development of a new individual from a germ cell without fertilization.

POLYPLOID—Normal body cells of the higher plants and animals have two sets of chromosomes (see *Diploid*). Polyploids are forms having three or more of these basic chromosome sets.

PROBABLE ERROR—A value that any given error will be as likely to fall under as to exceed. A measure of the reliability of a statistical quantity (Mean, etc.).

QUADRIVALENT—Chromosome association in groups of four.

ROGUE—A variation from the type of a variety or standard, usually an inferior or diseased plant.

SPORT—An abrupt deviation from type.

SEGREGATION—Separation of allelomorphic genes at meiosis.

SOMATIC—Referring to body tissues; having two sets of chromosomes, one set normally coming from the female parent and one from the male; as contrasted with germ cells having a single set of chromosomes.

TETRAPLOID—An organism characterized by a quadruplication of the basic haploid chromosome number.

TRIPLOID—An organism characterized by having three times the reduced primary chromosome number.

ZYGOTE—An organism produced by the union of two germ cells.

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